

ZOOLOGY.—On some western millipeds of the order Spirobolida.¹ RALPH V. CHAMBERLIN, University of Utah. (Communicated by C. F. W. MUESEBECK.)

The present paper aims to present some results of a review of western, chiefly Californian, millipeds of the order Spirobolida. The genera represented are regarded as falling into two families, the Spirobolidae sens. str. and the Atopetholidae, here more restricted than in earlier usage.

The study has been based primarily upon material in my own collection now housed at the University of Utah where types of the new forms are for the present retained. The diagnoses of new forms are based in the main upon features of the male gonopods and are made brief, more detailed accounts being reserved for later elaboration.²

Family SPIROBOLIDAE

This family as now conceived by the author is superficially characterized by having the second tergite produced conspicuously below the level of the end of the collum on each side. The gonopods are typically short and compact, without segmentation though sometimes with a free inner piece, each articulated to a conspicuously developed and strongly muscled basal support.

The genera occurring north of Mexico are *Spirobolus*, *Hiltonius*, *Auxobolus*, n. gen., *Californibolus*, and *Tylobolus*. In Mexico, in addition to *Hiltonius* and *Spirobolus*, the genera *Messicobolus* and *Aztecocolus* at present represent the family. Attention here is given chiefly to species that in recent years have generally been referred to *Tylobolus* but that here are distributed among several genera.

Auxobolus, n. gen.

This genus is proposed for a group of species differing from those of *Tylobolus* and *Californibolus* in that the coxal plates of the anterior gonopods but little, or sometimes not at all, exceed the sternite instead of meeting broadly in front of and caudad of it as they do in the other two general mentioned. From *Californibolus* it also differs in having the telopodite of the anterior gonopods distally strongly bent or subuncate

instead of remaining essentially straight, and from *Tylobolus* in the form of the posterior gonopods. Orthotype: *Auxobolus ergus*, n. sp.

Auxobolus ergus, n. sp.

Figs. 5-7

General color of the body reddish to chocolate-brown, with dark, nearly black, annuli, which are wider dorsally than down the sides. Legs reddish brown or chestnut. Darker individuals appear almost mahogany colored.

Clypeal foveolae 4-4. Eyes widely separated, their ocelli typically in 6 or 7 series.

Collum narrowed down the sides, margined along the anterior border below the level of the eyes, otherwise smooth or in some females with a shallow transverse furrow in front of the caudal border, this furrow almost sulciform toward its ends. The second tergite extending well below the lower end of the collum.

On the ordinary tergites the segmental sulcus is fine but distinct throughout; it bends forward to and embraces the repugnatorial pore. Segments strongly longitudinally striate beneath, but a wide space below each pore smooth and free of striae.

Last tergite essentially smooth except for a shallow transverse furrow in front of the caudal end. Anal valves prominent, smooth.

The characteristic features of the gonopods of the male are shown in Figs. 1, 2, and 3.

Number of segments, 51-53.

Length of male, 80 to 90 mm; width, 7 to 8 mm. Width of female up to 10 mm.

Type locality.—California: Tollhouse. Males and females taken March 23, 1941, by S. and D. Mulaik.

Other records.—California: Madero County; Kern County, 7 miles north of Glenvilles; also Clements. All collected by the Mulaiks in March 1941.

Auxobolus castaneus (Chamberlin)

Tylobolus castaneus Chamberlin, Proc. Biol. Soc. Washington 31: 166. 1918.

Type locality.—California: Brookdale.

Auxobolus claremontus (Chamberlin)

Tylobolus claremontus Chamberlin, Proc. Biol. Soc. Washington 31: 165. 1918.

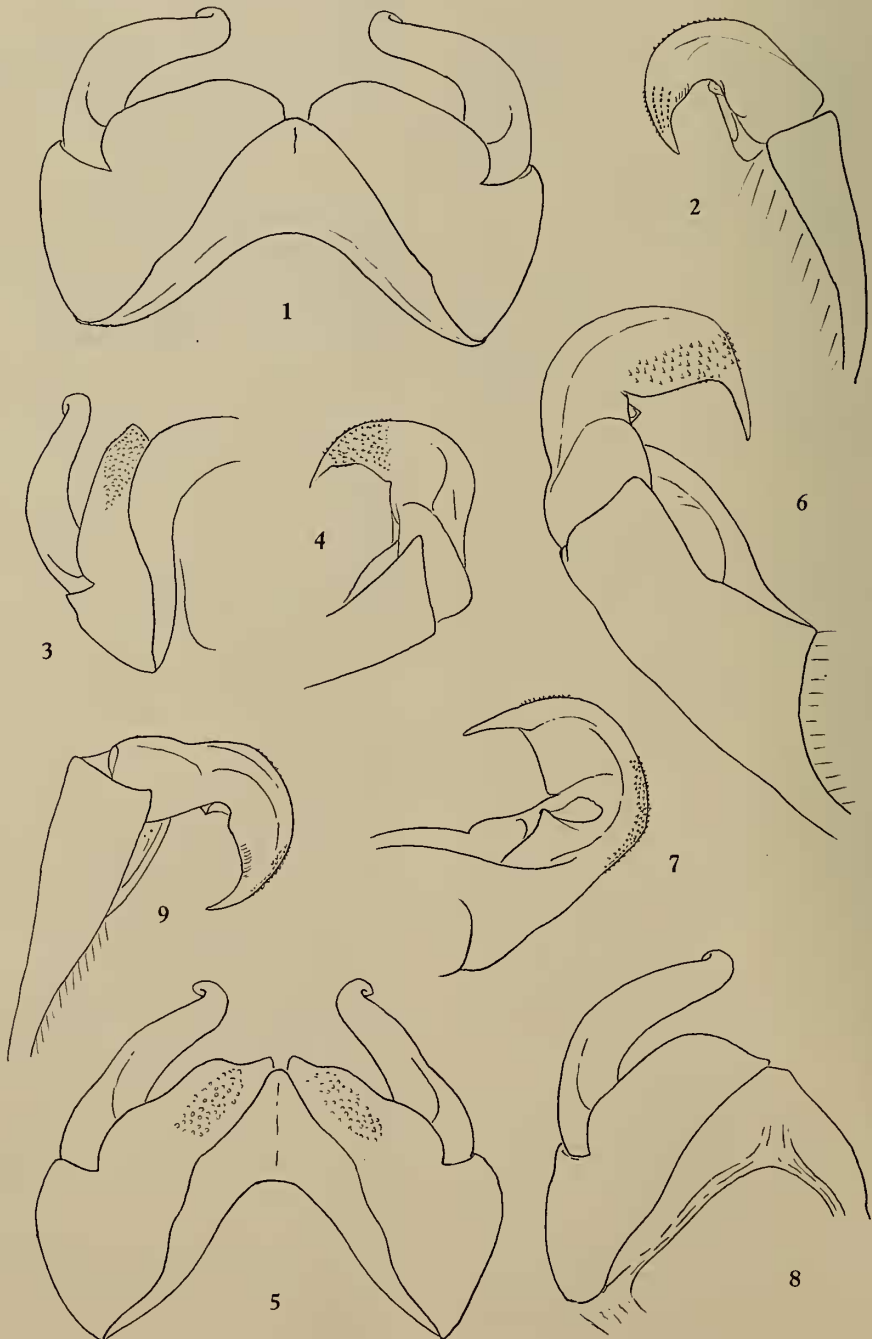
¹ Received January 18, 1949.

² In the references given in this paper under the various species, an asterisk (*) preceding a number designates a figure.

Type locality.—California: Claremont.

A common species in Los Angeles County.

Figures of the anterior and posterior gonopods are here given (Figs. 1, 2).



FIGS. 1-9.—1, *Auxobolus claremontus* (Chamberlin), anterior gonopods; 2, the same, right posterior gonopod, cephalic aspect; 3, *Auxobolus discipulus*, n. sp., anterior gonopods; 4, the same, right posterior gonopod, cephalic aspect; 5, *Auxobolus ergus*, n. sp., anterior gonopods; 6, the same, right posterior gonopod, cephalic aspect; 7, the same, right posterior gonopod, caudal aspect; 8, *Auxobolus friantus*, n. sp., anterior gonopods; 9, the same, left posterior gonopod, cephalic aspect.

Auxobolus discipulus, n. sp.

Figs. 3, 4

General background of body brown to more or less chestnut, darkened with dusky or black annuli, which embrace a variable proportion of the tergites. Legs brown.

An obviously smaller form than *ergus* and *friantus*, with which it agrees in the more general structural features. Separable from those species in having the distal margin of the anterior sternite of the gonopods widely rounded instead of more or less acuminate. The telopodite of the posterior gonopods has the characteristic form represented in Fig. 4. For anterior gonopods see Fig. 3.

Number of segments, 50-52.

Diameter of male, 5.5-6 mm; of female up to 6.5 mm.

Type locality.—California: Ione. Male and female, March 27, 1941, taken by S. and D. Mulaik.

Other record.—California: Vicinity of Stanford University. Autumn of 1921, collected by J. C. Chamberlin.

Auxobolus friantus, n. sp.

Figs. 8, 9

The general color of the body seems to have been chestnut, now faded from long preservation and probable drying at some time.

The female is smaller than that of *ergus*, but the male is of approximately the same size. It is most readily distinguished by differences in the gonopods. The characteristic form of the posterior gonopods is shown in Fig. 9. The difference in the form of the anterior sternite and the anterior gonopods will be evident on comparing Fig. 8 with the corresponding figure for *ergus*, Fig. 5.

Number of segments, 53-55.

Width of male, up to 8 mm; of female, up to 8.25 mm.

Type locality.—California: Fresno County, Friant. Males and females taken in March 1913 by R. V. Chamberlin.

Auxobolus monachus, n. sp.

Figs. 10, 11

Caudal borders of tergites chestnut; elsewhere more or less blackish, the black in part, especially just above the level of the pores, forming a network of lines. Legs light chestnut.

Clypeal foveolae 4-4.

Most readily identifiable by the form of the telopodite of the posterior gonopods as shown in Fig. 11. The anterior sternite of the anterior gonopods is also of a form different from that of the other known species and is shown in Fig. 10.

Number of segments, 48.

Diameter of male holotype, 7 mm.

Type locality.—California: Monterey County, Hastings Reservation. Male holotype taken March 17, 1940, by Dr. J. M. Linsdale.

Auxobolus simulatus, n. sp.

Figs. 12, 13

A lighter-colored form than the others here listed, the metazonites being chestnut behind the segmental sulcus and light brown to yellow in front of it. The legs are reddish yellow.

Clypeal foveolae 5-5.

The sternite of the anterior gonopods distally acutely pointed, and the coxites of the anterior gonopods distally rounded and rather widely separated from each other as shown in Fig. 12.

Number of segments, 49.

Diameter of male holotype, 7 mm.

Type locality.—California: Riverside. An adult male and a younger specimen were taken in November 1925 by J. C. Chamberlin.

Auxobolus stebbinsi (Chamberlin)

Tylobolus stebbinsi Chamberlin, Proc. Biol. Soc. Washington 57: 112; *4, 5. 1944.

Type locality.—California: Santa Monica Mountains, Meadow Canyon.

Genus **Californibolus** Verhoeff

Generotype: *Californibolus michelbacheri* Verhoeff.

This genus agrees with *Tylobolus* sens. str. in having the coxal plates of the anterior gonopods broadly in contact distad of the sternite, but differs in the form of the telopodite, which is more laminate and is distally straight and simply concave behind, not strongly curved or subuncate as it is in the other genus. Also the posterior gonopod does not present an obvious second distal lobe present in *Tylobolus*.

Six species, including three given as new, are referred to this genus and are listed below.

Californibolus michelbacheri Verhoeff

Californibolus michelbacheri Verhoeff, Bull. Southern California Acad. Sci. 43: 50; *12: 1, 2, 3. 1944.

Type locality.—California: Vicinity of Fort Seward.

Californibolus oregonus, n. sp.

Figs. 14, 15

The tergites in front of each segmental suture are yellowish, in part slightly reddish brown above, being on most segments dusky along and in front of the suture down the sides, with an annulus of more or less chestnut color behind the suture.

This species, like *pontis* and *rectus*, is smaller than the genotype. In the telopodite of the posterior gonopods the terminal spine, while similarly long, is proportionately thicker at base and more acuminate than in *michelbacheri*, and the general form of the telopodite is different both in the tibiotarsal and the femuroidal divisions. The sternite of the anterior gonopods is distally more acute than in the genotype and presents a furrow or notch at its distal end. See further Figs. 14 and 15.

Number of segments, 51.

Width, 5.2 mm.

Type locality.—Oregon: Springfield. One male taken October 29, 1927, by D. T. Jones.

Californibolus pontis, n. sp.

Figs. 18, 19

Body light brown, with chestnut annuli encircling caudal borders of tergites. Legs light brown.

A considerably smaller form than the genotype and composed of fewer segments. The telopodite of the posterior gonopods differs obviously in the shorter, more rapidly acuminate, terminal spine, in presenting an obtuse angle or tooth on the caudal margin of tibiotarsus, and in general form as shown in Fig. 19. While the anterior gonopods are of the same general form, the sternite differs in presenting an acute tooth or process at the distal end in being more strongly narrowed distad. See further Figs. 18 and 19.

Number of segments, 48.

Length, about 45 mm; width, 4.7 mm.

Type locality.—California: Bridgeville. Male holotype taken in March 1928 by J. C. Chamberlin.

Californibolus rectus, n. sp.

Figs. 16, 17

Brown, with pronounced black annuli back of the segmental sutures and also a black stripe in

front of each suture running from above level of pore and narrowing downward. Legs dusky brown, the proximal joints darkest.

The sternite of the anterior gonopods in outline acutely narrowing distad but very narrowly rounded at apex as shown in Fig. 16. Coxites of anterior gonopods of the same general form as in the other species but the telopodite differing at distal end as shown in the figure. The terminal spine of the posterior gonopods is slender, as in *michelbacheri*, but it is proportionately shorter, while there is a characteristic incision or notch on the mesal side where tibiotarsus meets the femuroidal division not present in other species. See further Fig. 17.

Diameter of holotype, 6 mm.

Type locality.—California: Solano County. One male from which the caudal end is lost.

Californibolus uncigerus (Wood)

Spirobolus uncigerus Wood, 1864, Proc. Acad. Nat. Sci. Philadelphia 1864: 15.—Trans. Amer. Phil. Soc. 13: 209; *36. 1865.

Tylobolus uncigerus (Wood) Cook, Harriman Alaska Exped. 8 (1): 67. 1904.

Type locality.—California.

Wood's figure for this species shows the distinctive features of the genus very well. I have not recognized his species in material so far seen.

Californibolus utahensis (Chamberlin)

Tylobolus utahensis Chamberlin, Pan-Pacific Ent. 2 (2): 60. 1925.

Type locality.—Utah: Zion National Park.

Genus **Hiltonius** Chamberlin

Orthotype: *Hiltonius pulchrus* Chamberlin.

This well-marked genus is represented in California by *H. balboanus*, *H. congregans*, *H. conservatus*, *H. mimus*, and *H. pius*, in Arizona by *H. thebanus*, and in Mexico by *H. carpinus*, *H. crassus*, *H. erythrotypus*, *H. federalis*, *H. michoacanus*, *H. tancitarus*, and *H. veracruzanus*, all named by the author, and *H. hebes* (Bollman).

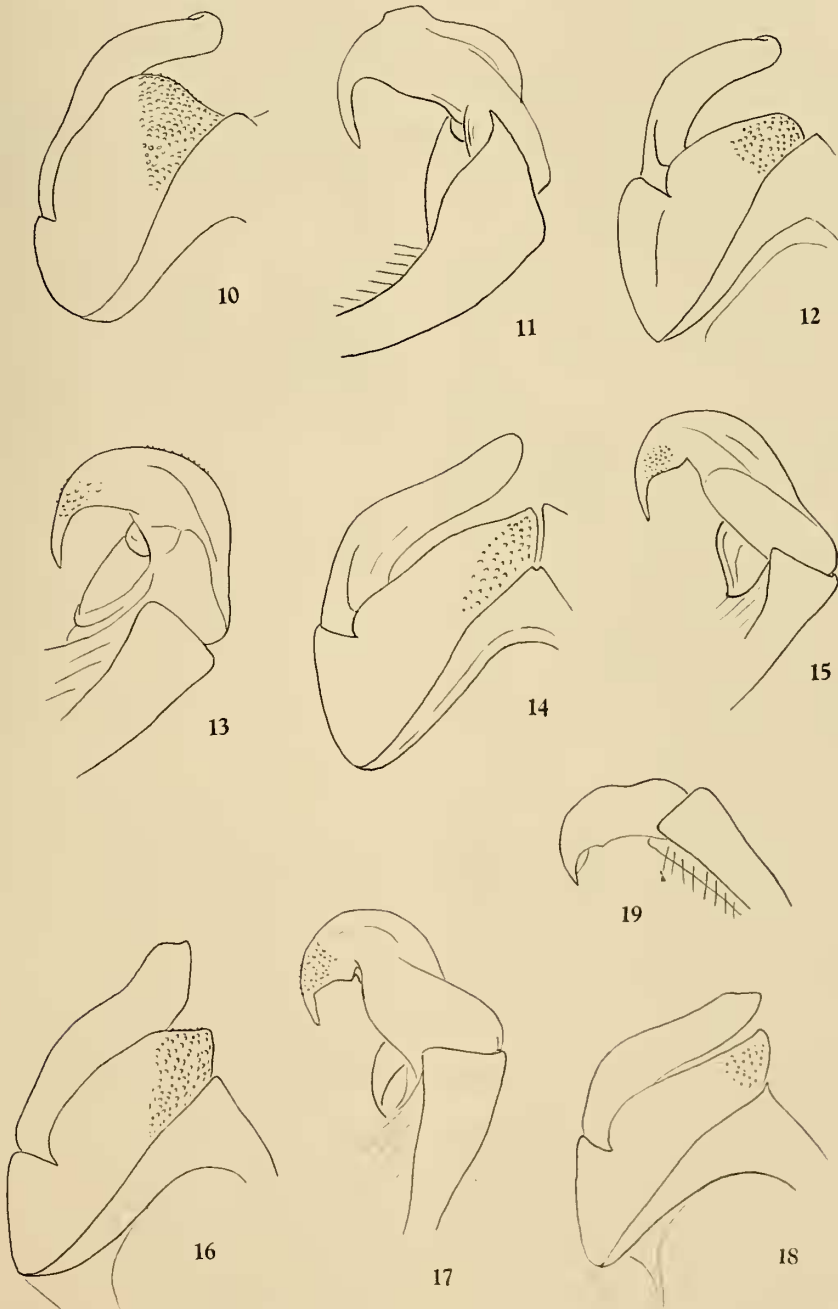
Genus **Tylobolus** Cook

Orthotype: *Tylobolus deses* Cook.

Differing from the other genera of the family in the form of the posterior gonopods. These have the general form and structure of those of *Auxobolus* but differ in the much greater length of the terminal spine and in the better-developed setae or prickles that extend to its tip, or very

nearly so, instead of their being present only at and proximal of the base of the spine, and also especially in presenting a conspicuous lamina or

lobe ectad of the base of the spine. It agrees with *Californibolus* and differs from *Auxobolus* in having the coxites of the anterior gonopods



FIGS. 10-19.—10, *Auxobolus monachus*, n. sp., anterior gonopods; 11, the same, right posterior gonopod, cephalic aspect; 12, *Auxobolus simulatus*, n. sp., anterior gonopods; 13, the same, right posterior gonopod, cephalic aspect; 14, *Californibolus oregonus*, n. sp., anterior gonopods; 15, the same, right posterior gonopod, cephalic aspect; 16, *Californibolus rectus*, n. sp., anterior gonopods; 17, the same, right posterior gonopods, cephalic aspect; 18, *Californibolus pontis*, n. sp., anterior gonopods; 19, the same, right posterior gonopods, cephalic aspect.

broadly in contact distad and caudad of the sternite.

Only the type species is at present known with certainty to belong to *Tylobolus* as here restricted.

Tylobolus deses Cook

Tylobolus deses Cook, Harriman Alaska Exped. 8 (1): 65; *4: 3a-3h. 1904.

Type locality.—California: Exact locality not known, but probably either the vicinity of Stanford University or of Claremont.

Family ATOPETHOLIDAE

Atopetholidae Chamberlin, Proc. Biol. Soc. Washington 31: 167. 1918.

Onychelidae Verhoeff, Zool. Anz. 122 (11-12): 273. 1938.

The millipeds of this family are in general mostly smaller than those of the Spirobolidae. Superficially they are characterized by having the lower ends of the collum acute and not exceeded below by the second tergite. The gonopods of the male are not articulated to a strongly developed basal support such as present in all members of the Spirobolidae but are characterized by having a separate basal segment set off by a definite suture or joint, this basal article tending to be placed transversely, i.e., to run mesad from the base of the telopodite

The genera now recognized as belonging to this family are *Anelus* Cook, *Atopetholus** Chamberlin, *Eurelus* Cook, *Gosichelus**, new, *Hesperolus** Chamberlin, *Onychelus** Cook, *Tidolus**, new, and *Watichelus**, new, of our own country, and the genera *Toltecolus* Chamberlin and *Tarascolus* Chamberlin of Mexico. The genera marked with asterisks occur in California and are further noted below.

Genus **Atopetholus** Chamberlin

Orthotype: *Atopetholus californicus* Chamberlin.

Five species have heretofore been described by the author under this genus: *A. angelus*, *A. californicus*, *A. carmelitus*, *A. fraternus*, and *A. parvicus*. A sixth species is here described as new. All six species are from California.

Atopetholus barbaranus, n. sp.

Tergites chestnut to black behind sulcus, in front of which brownish gray to darker brown. Legs from light chestnut to nearly black.

Clypeal foveolae 5—5.

Claws of first three pairs of legs longer than the ultimate joint. The coxae of these legs with swellings or pads beneath, while the coxae of the immediately following pairs are strongly compressed. Sternite of the third gonopod with the usual process.

The species may be readily distinguished from the others thus far known in having the distal end of the posterior gonopods with its border straight, not rolled in or recurved. The two fingers of the anterior gonopods are characteristically long, slender and divergent. The coxites of the anterior gonopods moderately extending beyond the sternite.

Number of segments, 48.

Length of male holotype, 40 mm; width, 5 mm.

Type locality.—California: Santa Barbara County at Orcutt. Several males and females.

Gosichelus, n. gen.

Closely related to *Atopetholus* but differing in the longer, distally narrower or more acuminate sternite of the anterior gonopods and in having the telopodite of the posterior gonopods simply incised or dentate at the tip, not strongly hooked as in the other genus.

Orthotype: *Gosichelus medolus* (Chamberlin).

Two species are at present known for this genus.

Gosichelus jaegeri (Chamberlin)

Onychelus jaegeri Chamberlin, Proc. Acad. Nat. Sci. Philadelphia 99: 50; *54, 55. 1947.

Type locality.—California: Riverside County, Colorado Desert.

Gosichelus medolus (Chamberlin)

Onychelus medolus Chamberlin, Bull. Univ. Utah, biol. ser., 6 (4): 13; *2: 17, 18. 1941.

Type locality.—Arizona: Olberg.

Genus **Hesperolus** Chamberlin

Orthotype: *Hesperolus wheelleri* Chamberlin. A monotypic genus.

Hesperolus wheelleri Chamberlin

Hesperolus wheelleri Chamberlin, Proc. Biol. Soc. Washington 31: 170. 1918.

Type locality.—California: Santa Ynez Canyon, Cold Spring Canyon.

Genus *Onychelus* Cook

Orthotype: *Onychelus obustus* Cook.

This genus, characterized by having the telopodite of the posterior gonopods in the form of a simple erect or falcate blade, embraces the following species: *O. michelbacheri* Verhoeff, *O. obustus* Cook, and *O. phanus* Chamberlin from the southwestern area in addition to *O. nigrescens* Chamberlin from Lower California.

Tidolus, n. gen.

Differing from *Atopetholus* in the smaller and simpler telopodite of the anterior gonopods, which does not present a caudally directed branch or process and which is concealed in front view by the coxite. Posterior gonopods comparatively large, each in the form of an elongate, curved or bent, lamina that gradually narrows distad and has its margins turned up so as to form a furrow or channel along mesocaudal side.

Orthotype: *Tidolus parvus* (Chamberlin).

This genus is, so far, monotypic.

Tidolus parvus (Chamberlin)

Atopetholus parvus Chamberlin, Proc. Biol. Soc. Washington 31: 168. 1918.

Type locality.—California: Claremont.

Watichelus, n. gen.

Differing from *Onychelus* in the much shorter, proportionately broader, sternite of the anterior gonopods, the large telopodite of which lacks the distal prolongation characterizing the other genus. In place of the simple blade representing the telopodite of the posterior gonopods in *Onychelus*, the telopodite in the present genus is distally furcate, with the principal branch simply dentate at its tip.

Orthotype: *Watichelus smithi* (Chamberlin).

This genus is as yet represented by a single species.

Watichelus smithi (Chamberlin)

Onychelus smithi Chamberlin, Proc. Acad. Nat. Sci. Philadelphia 99: 49; *52, 53. 1947.

Type locality.—California: Riverside County, Murray Canyon, about 3 miles north of Palm Canyon.

ICHTHYOLOGY.—*Keys to the genera of echelid eels and the species of Muraenichthys of the Pacific, with two new species.*¹ LEONARD P. SCHULTZ and LOREN P. WOODS,² U. S. National Museum.

The worm eels referred to the family Echelidae form a complex group of species, occurring in most of the warm seas of the world. They are difficult to identify, and some species appear to be allied to the Ophichthyidae but lack the sharp-pointed tail. No less than 22 genera have been placed in the family at various times. Among these the following have been assigned to other families: *Verma* Jordan and Evermann, 1896, apparently related to the Ophichthyidae; *Bathymyrus* Alcock, 1890,

¹ Published by permission of the Secretary of the Smithsonian Institution. Received January 31, 1949. The drawings were made by Dorothea B. Schultz.

² We wish to correct a printer's error in our last paper, "A New Name for *Synchiropus altivelis* Regan, with a Key to the Genera of the Fish Family Callionymidae," in this JOURNAL 38 (12): 420. 1948. Section 5b in the key is out of place as printed. It should have been placed before section 8a.

referred to the Congridae by Myers and Storey, 1939, who refer *Sinomyrus* Lin, 1933, to the Dyssomidae; *Merinthichthys* Rivero, 1934, which may belong to the Moringuidae; *Heteromyrus* Pietschmann, 1935, redescribed in 1938 by him and probably belonging with the Muraenidae; *Chrinorhinus* Rivero, 1932, probably belonging in the family Moringuidae, judged from notes on the type, kindly furnished by William C. Schroeder, of the Museum of Comparative Zoology. This leaves 16 genera, and there have been few attempts to compare them. Parr (Bull. Bingham Oceanogr. Coll. 3 (4): 8. 1927) clearly demonstrated the advisability of referring *Ahlia* to the synonymy of *Myrophis*. After examining the position of dorsal fin anywhere from over rear of head to a little behind anus and the variability of the dentition, we have gone still further